Research Note

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ASPEN SPROUT PRODUCTION AND WATER USE

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ABSTRACT

Sprouting response and soil moisture depletion on aspen plots were compared under four experimental conditions: (a) clearcut, (b) clearcut, stumps sprayed with sodium arsenite, (c) basal injection of sodium arsenite, and (d) control. Numbers of sprouts varied with treatment for 2 years, but after 4 years the numbers of sprouts on all plots were about equal. Clearcutting the aspen reduced soil moisture depletion by 3 to 4 inches in a 6-foot soil profile during each of three growing seasons.

The objectives of managing aspen (Populus tremuloides Michx.) in the Intermountain region can be quite diverse, including regeneration of commercial stands, revitalization of degenerate stands and, in some instances, stand manipulation to increase water yield. Regardless of the objectives, management can be successful only if both the treatment effects and their duration can be predicted. This study was begun to increase confidence in predictions of this type; more specifically, to test the effects of several management treatments on aspen sprout production, and also to evaluate the changes in soil moisture depletion following aspen removal.

STUDY AREA AND METHODS

Plots were established in a single aspen clone near the headwaters of Farmington Creek, Davis County Experimental Watershed, in Utah. The site is at 7,800 feet elevation on a northwest-facing 15-percent slope. At the time of the study, the clone had a two-storied aspen canopy (fig. 1) with average heights of 48 and 17 feet for the dominant and codominant trees, respectively. Basal area was 90 sq.ft./acre. The diameter (d.b.h.) of all trees on the control plots was measured. Only four were more than 10 inches d.b.h., 20 fell in the 5- to 10-inch d.b.h. class, and the remaining 97 averaged 2.4 inches d.b.h. A sampling of eight trees showed that diameter was a good indicator of age, with stem ages varying from 29 years for a tree 2 inches d.b.h. to 88 years for a tree 12 inches d.b.h.

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[1]Associate Forest Hydrologist, stationed in Logan, Utah, at the Forestry Sciences Laboratory, maintained in cooperation with Utah State University. The author acknowledges the work of John D. Schultz, Assistant Professor of Forest Science, Utah State University, who planned the study and completed the preliminary treatments while he was a Research Forester with the Intermountain Station.

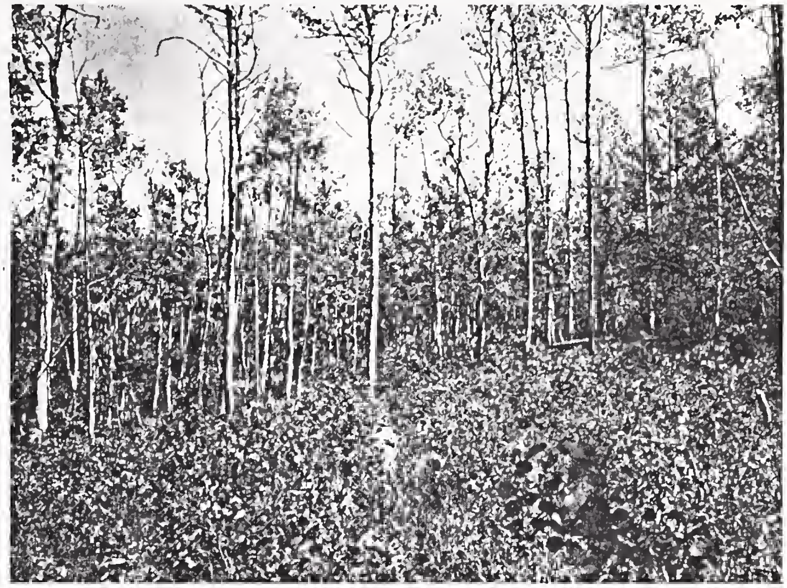

Figure 1.--A portion of the study area showing the aspen sprouts on some of the treated plots in the foreground and undisturbed double-canopied aspen clone in the background. A recording rain gage is in the center of the cleared plots.

Soils on the study area are deep, well drained, and colluvial. They vary with depth from a sandy loam to a very gravelly clay loam. Parent materials are sandstone, gneiss, and schist.

In an area measuring 100 by 150 feet, nine adjacent plots were established in the clone in a three-by-three pattern. Three additional plots were designated as controls at the lower end of the area. Each plot was divided into 16 subplots of 1 milacre each. To isolate the root systems, a trench 2 feet wide and 3 feet deep was dug around each plot, lined with roofing paper, and refilled. An 8-foot fence enclosed the entire study area, thereby excluding deer and stray sheep.

Three treatments, each with three replications, were completed on the nine plots in the summer of 1963. Treatments included (a) clearcut, (b) clearcut with all stumps sprayed with sodium arsenite, and (c) basal injection of all stems with sodium arsenite using the "Little Tree Injector."[2]

Aspen sprouts were counted on each plot early in the growing season and again in the fall, from 1964 through 1967. In addition, a complete survey of vegetation in 1966 quantified the heavy ground cover of vegetation and litter on both the treated and control plots (table 1). The percentage composition by species is presented in table 2.

Table 1.--Ground cover on control and treated plots

Type	Control plots	Treated plots
	Percent	
Vegetation	67	75
Litter	27	18
Bare soil	6	7

[2]Use of trade names herein is for identification only and does not imply endorsement by the USDA Forest Service.

Table 2.--Vegetative composition on control and treated plots

Species	Control plots	Treated plots
	- - - - - - Percent	- - - - - -
Populus tremuloides[1]	6	16
Symphoricarpos spp.	43	10
Bromus carinatus Hook. & Arn.	16	18
Hackelia floribunda (Lehm.) I. M. Johnston	1	8
Senecio serra Hook.	2	6
Valeriana occidentalis Heller	2	12
Remaining species	30	30

[1]Stems less than 6 feet tall.

Two soil moisture access tubes were installed on each of the control and clearcut plots. With a neutron probe, soil moisture measurements were made to a depth of 6 feet at least three times during each of the 1965, 1966, and 1967 growing seasons.

RESULTS

ASPEN SPROUTING

The effects of the three treatments on aspen sprouting are shown in figure 2. Although a considerable difference in sprout numbers is apparent during the first 2 years after treatment, the difference rapidly diminishes thereafter. A general decline in the numbers of sprouts occurred each year between the beginning and end of each growing season. During the 4 years following treatment, the basal injection of sodium arsenite consistently produced the lowest number of sprouts. However, there was no statistically significant difference in sprout numbers among treatments at any time, because the experimental design was not sensitive enough to reveal it. Sprout numbers frequently ranged from 0 to more than 30 stems (0 to 30,000/acre) on the milacre subplots; but when calculated on a whole plot basis, the numbers of sprouts never exceeded 21,000 stems per acre.

SOIL MOISTURE DEPLETION

Clearcutting the aspen noticeably affected soil moisture depletion (table 3). The initial measurements were very similar in each of the 3 years. The difference between initial and final measurements each year clearly indicates 3 to 4 inches less soil moisture consumption on the clearcut plots. Rainfall totaled 5.87 inches from July to October 1965, more than four times the amount for the same period in 1966. It is assumed that both surface runoff and deep percolation losses were insignificant during the growing season; therefore, summer precipitation is added to the soil moisture depletion to estimate evapotranspiration losses (table 3). Evapotranspiration losses averaged 3.26 inches less from the clearcut than from the control plots.

Figure 2.--Aspen sprout numbers, 1964-1967, following three treatments to the parent stand in 1963. Sprout numbers are an average of three plots.

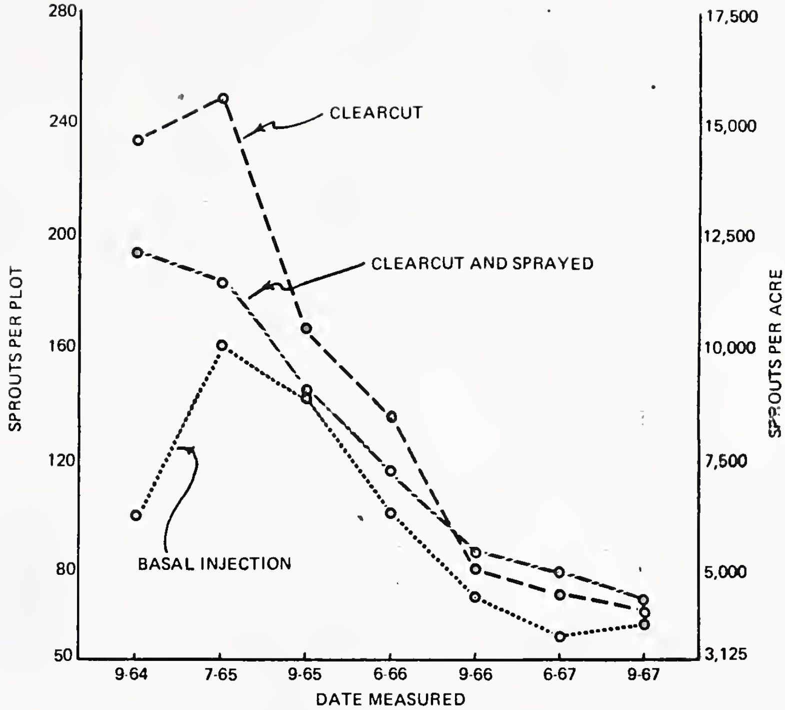

Table 3.--Soil moisture depletion and evapotranspiration in control and clearcut plots, 1965-1967

Item	1965		1966		1967	
	Control	Clearcut	Control	Clearcut	Control	Clearcut
	Inches					
Initial moisture content[1]	20.92	21.63	20.72	20.61	21.52	21.55
Final moisture content	15.67	19.60	11.21	14.65	10.86	13.91
Soil moisture depletion	5.25	2.03	9.51	5.96	10.66	7.64
Growing season precipitation	5.87	5.87	1.01	1.01	2.47	2.47
Evapotranspiration	11.12	7.90	10.52	6.97	13.13	10.11
Evapotranspiration difference	3.22		3.55		3.02	

[1]Each soil moisture measurement is the average water content for a 6-foot depth calculated from two access holes on each of three plots.

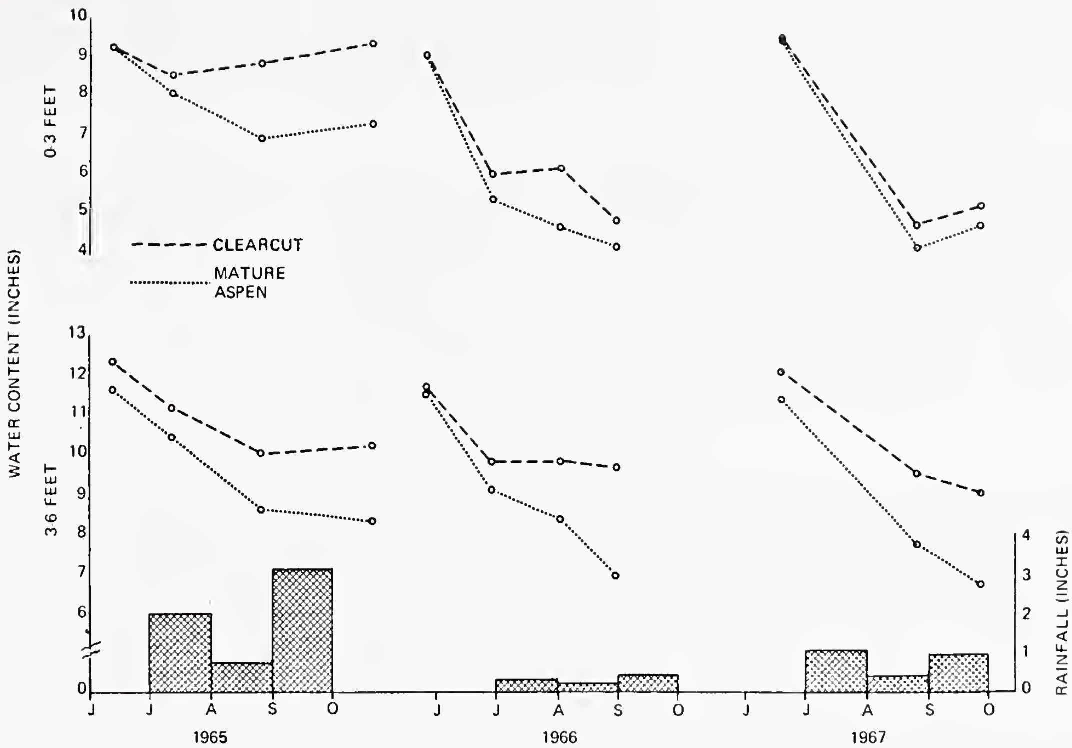

Figure 3.--Moisture content in the 0- to 3-foot and 3- to 6-foot soil profiles.

The soil moisture measurements are separated for the upper and the lower 3 feet of the profile and presented in figure 3. Each year, at both depth ranges, there was less soil moisture depletion in the clearcut plots than in the control plots. The greatest reduction in water loss from the surface 3 feet occurred in 1965, the second year after treatment. The reduction declined substantially in succeeding years. Clearcutting reduced soil moisture loss in the 3- to 6-foot portion of the soil profile by an average of 2.3 inches per year. Water content was much more consistent in this lower portion of the profile than in the surface soils.

Summer precipitation has the greatest influence on moisture content in the surface few feet of soil. In both 1965 and 1967, soil moisture increased at the end of the season in response to late season rain. Summer rainfall in 1965 was above average and is reflected by the high water content in the soils throughout the season.

DISCUSSION

Although the experimental design did not allow the detection of a statistically significant difference in the number of sprouts at any time after treatment, it is apparent that within the limits of this clone the various treatments do affect the number of sprouts, at least during the few years immediately following treatment. The general decline in number of sprouts may be attributed to competition between sprouts and with other species. The results indicate that aspen regeneration is neither improved nor retarded beyond the first few years by the treatments used in this study.

The clonal growth habit of aspen is responsible for considerable genetic variability among aspen stands. This variation is manifested in the ability of a given stand to produce suckers.[3] [4] Study of numerous other clones is required before treatment results such as those of the present study can be confidently extrapolated over large areas.

This study contributes to the large number of observations concerning the water savings that can be realized by removing deeply rooted vegetation. Here 3 to 4 inches of soil moisture were "saved" each year in the 6-foot profiles of the clearcut plots. Although the treatment effect was reduced as time passed, 4 years after treatment the reduction in soil moisture depletion was still 3 inches. The reduction in water consumption occurred mostly in the lower 3 feet of the profile. We can expect the total reduction in water loss to be greater than the measured 3 to 4 inches if the water loss measured on the control plots from the 6-foot depth to a depth of maximum root penetration is included. The maximum rooting depth of aspen often extends to 9 or 10 feet, but varies greatly with soil type and depth.[5]

The three control plots could have been more appropriately located throughout the study area, rather than all placed below the clearcut plots. However, the difference in position on the slope between the two treatments probably has not greatly affected the conclusions regarding water consumption. The maximum distance between soil moisture access holes on the clearcut and control plots is less than 150 feet and the slope is moderate. Differences in soil moisture attributable to slope position would, if anything, have produced a conservative measurement of soil moisture use between treatments.

A minimum of 3 to 4 inches of water to a depth of 6 feet can be "saved" on some sites by removing aspen. Theoretically, the water saved becomes available for a higher priority use at some future time and place. This saving can be expected for several years after treatment.

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[3]Barnes, B. V. The clonal growth habits of American aspen. Ecology 47(3):439-447. 1966.

[4]Garrett, P. W., and R. Zahner. Clonal variation in suckering of aspen obscures effect of various clearcutting treatments. J. Forest. 62(1):749-750. 1964.

[5]Gifford, G. F. Aspen root studies on three sites in northern Utah. Amer. Midland Natur. 75(1):132-141. 1966.